



July 6, 2021

EPA Region 8
1595 Wynkoop St.
Denver, CO 80202

Class II Permit Application #WY22425-12116,
Brinkerhoff 3A Well (API: 49-013-06977)

Response to EPA Preliminary Technical Review

Dear Mr. Brown:

Merit Energy has completed our review of the comments provided in The EPA's Preliminary Technical Review letter dated May 15, 2021, for the Brinkerhoff 3A Class II injection application. Merit Energy's response which follows, consolidates, and provides response to each of the comments.

Comment 1: The 7520-6 permit application form and attachments indicate the purpose of the conversions for enhanced oil recovery (EOR); however, the cover letter indicates the application is for saltwater disposal. Please clarify whether the conversion of the well is for EOR or disposal.

Response: The Brinkerhoff 3 Class II permit will be strictly for EOR purposes.

Area of Review (AOR) and Corrective Action:

Comment 2: Please provide the current list of landowners and addresses within ¼ mile of the Tribal C-14 facility boundary as required in 40 Code of Federal Regulations (CFR) 144.31(e)(9).

Response:

- a. There is not a Tribal C14 facility in the Steamboat Butte field.
- b. Merit Energy Company is Operator and Lessee
- c. All addresses for landowners the Brinkerhoff 3A are:

Mr. Vernon Hill, Chairman
Eastern Shoshone Business Council
14 North Fork Road
Ft. Washakie, WY 82514



Mr. Lee Spoonhunter, Chairman
Northern Arapaho Business Council
533 Ethete Road
Ethete, WY 82520

Comment 3: Please provide all available well construction, completion records and sundry notices for wells located within the AOR that penetrate the confining zone as required in 40 CFR 146.7(g).

Response: Provided in Appendix A.

Comment 4: Section L of the permit application indicates that the Brinkerhoff 3 well was plugged and abandoned in 1966 after many joints of tubing became stuck in the hole. Please provide plugging records and a diagram depicting the completion details and final plugging and abandonment of the Brinkerhoff 3 well. Additionally, please provide the lateral distance in feet (ft.) between the Brinkerhoff 3 and 3A well bores.

Response: Plugging record and wellbore diagrams are also included in Appendix A. The Brinkerhoff 3 and Brinkerhoff 3A are 749 feet apart.

Comment 5: Well records on file with the Wyoming Oil and Gas Conservation Commission (WOGCC) indicate that the Brinkerhoff 3 well was drilled in 1959 with perforations in the Tensleep Formation and was subsequently recompleted with perforations in the Dakota Formation in 1966. The Table in Exhibit B-1 indicates that the top of cement behind the production casing for the Brinkerhoff 3 well is 2,700 ft. based on a calculation of cement circulated through a D.V. tool reportedly located at 4,708 ft. The Plugging and Abandonment (P&A) Plan for Brinkerhoff 3A well in Exhibit I also indicates an estimated top of cement behind casing of 2,700 ft. with a D.V. tool set at 4,708 ft. Please provide the supporting records and cement bond log (CBL) that verify the location of the D.V. tool (whether at the Brinkerhoff 3 or 3A well), reported cement volume and top of cement. Additionally, provide the top of cement above the original seven (7) inch casing completed to a depth of 7,076 ft. in 1959 for the Brinkerhoff 3 well.

Please be advised that the permit applicant must make a clear demonstration that the Brinkerhoff 3 well was completed and subsequently abandoned in such a way that it does not represent a conduit for movement of injected fluids out of the Crow Mountain Sandstone Member of the Chugwater Formation. Failure to make an adequate demonstration may result in denial of a Class II permit or incorporation of a corrective action requirement to ensure isolation of the proposed injection zone.

Response:

a. Brinkerhoff 3 was drilled in 1948 and was completed in the Phosphoria. The 7" casing was completed in two stages, 300 sx from the shoe and an additional 400 sx from the D.V. tool. There was no CBL or temperature survey ran, but conservative cement calculations assuming 25% losses inside of the 8.75" x 7" annulus with a yield of 1.16 cu. Ft/sk put the TOC for the 1st stage at 5340' (covering the Curtis aquifer by 199') and the TOC for the 2nd stage to be at 2700'. In 1961 Dakota perforations were added and the Dakota reservoir produced paying quantities of oil (96 BOPD) with limited water @ 6% watercut. The Dakota is not believed to be a viable aquifer due to this oil production. The Dakota perfs



were already squeezed per the 1966 completion report that contains the fishing. No record of this squeeze can be found however. The Brinkerhoff 3 wellbore was ruined during milling operations on a fish in 08/1966, and approval to plug was given by the USGS. A 252' cement plug was set on top of the fish, isolating the hole in casing and Phosphoria perfs from the rest of the well. This plug also isolates the entire Curtis reservoir within the wellbore of the Brinkerhoff 3 by covering both the top and bottom of the Curtis. Additionally, a separate 189' cement plug was set over the already squeezed Dakota perforations, providing another level of protection.

b. Merit believes the initial completion cement job calculations and the 1966 plugging to be sufficient to both isolate the Curtis aquifer from cross flowing into other zones within the Brinkerhoff 3 wellbore.

c. The Plugging and Abandonment plan for the Brinkerhoff 3A TOC was incorrectly stated at 2700'. The Brinkerhoff 3A TOC is 5514' which is confirmed by a CBL ran 10/17/1966. This is the source of confusion on the original submittal. The Plug and Abandonment procedure for the 3A has been corrected and is attached to this response as Exhibit B.

d. Brinkerhoff 3A was drilled in 1966 as a replacement to the Brinkerhoff 3. It was completed with Phosphoria perfs, not Tensleep. All completion records are Phosphoria. Please see the included wellbore diagrams and completions for supporting documentation.

Injection and Confining Zone Geology:

Comment 6: In support of a determination regarding corrective action under 40 CFR 146.7, please provide an indication as to whether any existing, proposed, or plugged and abandoned well conditions exist that represent a potential pathway for out of zone injection.

Response: Merit believes no corrective action is required to remediate a pathway out of zone prior to injection. Both the Brinkerhoff 4 and Brinkerhoff 3A have CBLs that show quality cement isolating the Curtis. These CBLs are included in Appendix C and D. The Brinkerhoff 3 cement calculations that show the same are detailed in the answer to question #5 and represented in the attached WBD and plugging report.

Comment 7: The formation top and bottom depths presented in the Brinkerhoff 3A UIC Application AOR Review spreadsheet appear to have been duplicated from the information included with the recent Tribal C-13 permit modification application. The Tribal C-13 well is located approximately three (3) miles northeast, and the formation top and bottom depths are not adequate or representative of the geologic conditions that exist at the location of the Brinkerhoff 3A well.

Response: These tops were copied from the C13 submittal in the excel file titled b." Brinkerhoff 3A UIC Application AOR review" withing the tab for the injection wells. This mistake is corrected and a separate 'Appendix E -Formation tops within the AOR' has been included in this response that has all the correct information.



Comment 8: Please provide the formation top and bottom depths and a lithologic description of each formation or named stratigraphic unit from surface to the depth of the deepest well completed in the AOR.

Response: Information in attached Appendix E.

Comment 9: Section G of the permit application indicates that the Crow Mountain Sandstone is 999 ft. thick; this thickness corresponded to the entire thickness of the Chugwater Formation. The aquifer exemption attachment indicates that the Crow Mountain Sandstone is 113 ft. thick. Please clarify whether the entire 999 ft. Chugwater Formation is being proposed as the injection zone or only the interval containing the Crow Mountain Sandstone Member reportedly occurring between 5,700 feet-Kelly Bushing (ft-KB) and 5,813 ft-KB. If the entire Chugwater Formation is being proposed as the injection zone, the confining intervals identified in the aquifer exemption attachment will need to be updated.

Response: This aquifer exemption is only being applied for within the Crow Mountain (Curtis) subunit of the Chugwater geologic unit. Not the entire Chugwater.

Comment 10: As provided in 40 CFR 146.24(5), please provide the following geologic data to support the application:

Response:

- a. Estimates of the permeability (if available) and net thickness of the porous/permeable portion of the injection zone. For example, is the entire 113 ft. of the Crow Mountain Sandstone considered porous/permeable as evidenced by open hole logs, or is there a smaller interval coincident with the existing ten (10) ft. perforated interval within the unit that is expected to receive the majority of the injected fluid?
 - i. Information included in Appendix F.
- b. An estimate of the net shale/impermeable unit thickness and permeability of the upper and lower confining zones.
 - i. Information included in Appendix F.
- c. Describe any known or suspected faults or fracture systems (e.g., Steamboat Butte Fault System to the west of the Brinkerhoff 3A well) and provide the proximity to the injection zone and the effect the fault or fracture system may have on injection activities.

The Steamboat Butte anticline is one of several anticlinal echelon structures striking in a northwesterly direction for about 50 miles parallel to the mountain front of the Wind River Range. These structures are bound by a basement-derived regional listric thrust fault dipping to the northeast and offset from one another in the northeast-southwest direction by a series of basement bound shear zones. The region thrust fault runs through the WSE Sec 8, T3N, R1W, approximately 0.75 miles, from the Brinkerhoff 3A injection well at the nearest point. Minor low-angle synthetic thrust faults confined to upper cretaceous shales have been identified in well logs and are thought to be associated with folding. These synthetic faults are typically observed proximal to the regional thrust plane and have not been identified in the AOR (Murphy and Roberts, 1954).



Normal faulting of major displacement is present on the west flank of the anticline and strikes north-northwest. The normal fault zone is roughly 500ft wide and fault planes dip 60-75° west-southwest. The normal faulting intersects the regional thrust plane in the Mowry shale with a measurable displacement of 1,200'. Delineation of the normal fault zone can be traced at the surface approximately 0.5 miles west of the proposed injection well (Murphy and Roberts, 1954). The Normal fault outcrops to the west of the AOR and dips to the west and crosscuts the regional trust fault in the strata overlying the injection zone; therefore, the normal fault zone is isolated from any interaction with injection fluids.

Due to the limited production from the Crow Mountain sandstones efforts to identify and characterize the effects and intensity of an in-situ fracture network have not been made. Core analysis and descriptions from 6 wells throughout Steamboat Butte field do not mention the presence of fracturing or contain anomalously high permeability values that would suggest the presence of micro-fracturing. Based on the sustained pressure depletion within the Crow Mountain sandstones and a cumulative WOR of 1.35, inferred fracture intensity is minimal, and if present, completely confined to the producing interval.

Murphy, J.F., and Roberts, R.W., 1954, Geology of the Steamboat Butte-Pilot Butte Area, Fremont County, Wyoming: U.S. Geol. Survey Oil and Gas Inv. Map OM 151

d. A description of the nearest out-crop of the Chugwater Formation and/or Crow Mountain Sandstone Member relative to the Brinkerhoff 3A well with accompanying geologic map.

The nearest Chugwater Group outcrop to the Brinkerhoff 3A injection area is located approximately 14 miles North-Northwest along the Maverick Springs anticline. However, out-cropping of the Crown Mountain sandstone (the injection zone within the Chugwater Group) is not observed within the Maverick Springs, instead the injection zone likely outcrops at the Circle Ridge anticline (20 miles from the injection zone) where the entire Chugwater Group can be traced in outcrop. At the outcrop, the basal Crow Mountain sandstone can be identified as a regressive lithology (non-ridge forming) directly atop the Alcova limestone that locally serves as a rim rock for one of the numerous "hogback" ridges surrounding Circle Ridge field. The presence of heavily cemented upper Crow Mountain sandstone is not confirmed suggest the unit likely pinches out between the injection AOR and the outcrop. The map for this outcrop is contained in Appendix G.

e. North-to-south and west-to-east oriented stratigraphic and structural cross-sections using well logs from off-set wells extending through the ¼ mile AOR. The cross-sections should depict formation tops, upper and lower confining zones, the injection zone, and known or potential USDWs above and below the injection zone.

i. Cross sections included in Appendix H.

f. Any available structural geologic or formation isopach maps for the injection zone or confining zones within the AOR.

g. Any available open or cased hole logs for the Brinkerhoff 3A well.

i. Three logs are available for the Brinkerhoff 3A, it is a GR-Neutron and CBL log ran in 1959. These logs are attached in Appendix C.

1. GR – Resistivity/SP

2. GR – Sonic log



3. GC – CBL log

Comment 11: (There are 2 #10 Comments) Section L of the application indicates that the Brinkerhoff 3A well was sand frac'd in 1983. The upper confining zone described in the aquifer exemption attachment is 161 ft. thick. Please provide a modeled estimate of the fracture height generated by the 1983 well stimulation activities and an assessment as to whether this activity may have propagated fractures in the upper confining zone.

Response: The frac information is included in Appendix A within the daily report for 6/20/1983 on the Brinkerhoff 3A 1987 completion report. This report claims "when sand hit csg perforation pressure increased from 2000 psi to 4000 psi" while pumping the early stages of a job at an injection rate of 6 bbl/minute. This frac job screened out after a total job of only 142 bbls (6000 gallons) 1500 lbs of 100 mesh sand had entered the perforations. A frac this small would not have been large enough to leave the sandstone of the Curtis unit, and with the low injection rate of only 6 BPM the fracture pressure would not have propagated to the upper or lower confining zones. Additionally, Merit does not have a Di-pole sonic log across the Crow Mountain in the Steamboat Butte field, which is a requirement for any software based frac model. Therefore, Merit assesses the stimulation did not penetrate through the upper confining zone.

Comment 12: In support of a determination that operation of the well as a Class II EOR well conforms to the prohibition of fluid movement contained in 40 CFR 144.12(a), please provide an evaluation as to whether the upper and lower confining zones consist of impermeable barriers of sufficient thickness and lateral extent to prevent movement of fluid out of the proposed injection zone within the AOR.

Response: This information is also included in Appendix F.

Underground Source of Drinking Water (USDW) Evaluation:

Comment 13: The information on USDWs appears to represent the same data points as those reported for the recent Tribal C-13 permit modification application, and this data was derived from an earlier application submitted in 2006. Please provide a current and updated summary of formation water quality data (i.e., maximum, minimum, median) available for the Steamboat Butte Field. One source of information pertaining to formation water quality sample results may be found at https://www.usgs.gov/centers/eersc/science/oil-and-gas-waters-project?qt-science_center_objects=0#qt-science_center_objects.

Response: Using the source provided in the link Merit put together a table containing minimum, median, and maximum TDS values for each USDW in the Steamboat field. This table is in Appendix J.

Comment 14: The table of possible USDWs in Section E of the permit application does not include any water quality information pertaining to the Nugget, Sundance, Lakota, or Dakota Sandstones located above the proposed injection zone or the Dinwoody, Phosphoria and Tensleep Formations located below the proposed injection zone. Please provide any water quality data for these formations and stratigraphic units. Specifically, please provide an indication of the maximum, minimum, and median Total Dissolved Solids (TDS) concentrations and USDW status of these units. If no water quality sample



results are available, please provide estimates of TDS concentrations from the cleanest water-bearing zones of the units using available open-hole resistivity and porosity logs from the Brinkerhoff 3A well or other off-set wells.

Response: Information for the requested zones is also included in Appendix J.

Faults, Fractures, Seismicity:

Comment 15: As provided under 40 CFR 146.24(5), please provide a brief evaluation of seismic risk associated with the proposed injection well, whether by injection induced seismicity or damage to the well potentially resulting from regional seismic events. Information pertaining to seismic risk and historically recorded seismic events in the region may be obtained from <https://earthquake.usgs.gov/>.

Response: According to the USGS earthquake and seismic hazard data, the AOR is situated in an area of the long term seismic hazard model with a 2% probability of exceeding 0.14g peak horizontal acceleration (PHA), and a 10% probability of exceeding 0.05g PHA, within the next 50 years (based on NEHRP B/C site class and $V_s30=760\text{m/s}$ – B&C site classes are dense soil/soft rock to hard rock which is applicable to the injection site).

With respect to induced seismic activity, the injection site, along with the remainder of the Wind River Basin, is not within one of the USGS's 21 distinct areas impacted by induced earthquakes identified as part of the 2016 model of short-term induced seismic activity. Further revisions of the model have failed to identify an increasing probability of induced seismicity in the area, with the latest model (2018) attributing <1% chance of minor-damage from either induced or natural earthquakes.

Merit has been unable to uncover any history of seismic events in the Steamboat butte field since Discovery in 1943. Waterflooding began in 1953 and a total of 710+ Million barrels of water for enhanced oil recovery purposes has been injected into the Tensleep, Phosphoria and Nugget formations as of 2021. The Brinkerhoff 3A conversion from a producing well into Class II-EOR injector is not expected to bring on an onset of seismic activity. Although the Brinkerhoff 3A will be injecting into a new formation with the field, the same practices which have been used in the other three exempted aquifers will be applied. Steamboat Butte field as a whole produces with a net injection to production ratio of less than one. The Surface discharge system allows for the discharge of produced water that meets the NDPES requirements. Additionally, the Brinkerhoff 4 which is offset is meant to act as a pressure relief to this waterflood. This practice prevents excessive reservoir pressure buildup that would be able to affect any of the nearby faults.

Well Construction:

Comment 16: Please provide the results of a Part I casing pressure test for the Brinkerhoff 3A well. If such testing results are not available, please submit a plan to perform this testing in accordance with EPA Region 8, Guidance Document #39 to support a determination that the well has mechanical integrity, as defined in 40 CFR 146.8(a)(1). This guidance document can be found at <https://www.epa.gov/uic/underground-injection-control-epa-region-8-co-mt-nd-sd-ut-and-wy>.



Response: Merit proposes to conduct a part I MIT as a condition of approval and prior to any injection with this permit. The current wellbore construction and producing equipment does not isolate the active Crow Mountain (Curtis) perms from the casing and does not allow for an MIT to be completed. The equipment needs to be converted to an injection string containing a packer before the MIT can be completed. The proposed WBD construction that will occur prior to this MIT is included in Appendix K.

Comment 17: Please provide a cement bond log (CBL) for the Brinkerhoff 3A well. Additionally, please provide an evaluation of the CBL in the confining zones located above and below the proposed injection zone and relative to the two (2) former perforation sets occurring between 6,692-6,712 ft-KB and 6,774-6,785 ft-KB. This evaluation should include calculation of an 80% bond index, identification of any zones of poor cement bond, and an indication as to whether the CBL supports that the well is cased and cemented in a manner that will prevent movement of fluids into or between underground sources of drinking water, pursuant to the requirements of 40 CFR 146.22(b) and 40 CFR 146.8(a)(2). Guidance No. 34 located at <https://www.epa.gov/uic/underground-injection-control-epa-region-8-co-mt-nd-sd-ut-and-wy> includes additional information on CBL analysis.

Response: A CBL for the Brinkerhoff 3A was run in 1966 and is submitted with this response in Appendix C. This CBL shows the TOC to be 5514' which is more than 100' above the proposed injection zone.

Comment 18: The well diagram included as exhibit H indicates that a cement retainer has been set at 6,180 ft-KB and a cast iron bridge plug set at 6,760 ft-KB. Please provide records documenting the abandonment and volume of cement squeezed for the two (2) perforation sets occurring between 6,692-6,712 ft-KB and 6,774-6,785 ft-KB. If no cement was placed on top of the cement retainer set at 6,180 ft-KB, please provide a plan to pressure test the retainer and top with a cement plug of at least 20 feet (and preferably 100 feet) as part of the proposed injection well conversion.

Response: The Completion work contained in the file 'Brinkerhoff 3A 983 Frac Completion report' contained in Appendix A shows that the plug set at 6180' has 8' of cement on top of it. No records that have an exact description of how much cement was pumped below the retainer to plug the Phosphoria reservoir can be found. The report file labeled 'Brinkerhoff 3A Card file' shows that the Brinkerhoff drilling company reported that they had plugged the Phosphoria reservoir as of 12-20-1982. The Crow Mountain (Curtis) reservoir was then completed in 1983. Merit proposes to leave current plug-in place because there would be unnecessary risk of wellbore failure attempting to drill out the cement and plug set at 6172' and 6180' respectively just to set another plug and cement again.

Comment 19: As required in 40 CFR 146.22(b)(1), all Class II injection wells shall be cased and cemented to prevent movement of fluids into or between USDWs. Pending the results of the responses to comment nos. 4, 9, 10 and 11, a work plan may be requested to isolate USDWs and incorporated as a pre-injection requirement for the conversion of the Brinkerhoff 3A well.

Response: Merit's analysis of the Brinkerhoff 3A and two wells within the Area of Review concludes that there is currently no pathway for injected fluid migration into or between USDWs. This will be confirmed after the injection string is run on the Brinkerhoff 3A and part I MIT completed.



Operating Conditions:

Comment 20: Please provide a flow diagram of fluid flow through the facility and a diagram of the facility surface construction, as described in Section K of the application. The diagram of the facility surface construction should depict the approximate location of devices to monitor the nature of the injected fluids, injection pressure, annulus pressure, flow rate, etc.

Response:

- a. Appendix L - PFD titled SB_E5_Batt_Waterhandlingsys. The Brinkerhoff 3A will be tied into the common field injection system that is already in place. Monitoring will be conducted with the following:
- i. Merit already submits a E5 battery injection system sample taken and submitted to EPA as part of our annual injection reporting. This water will be the same injected water we use fieldwide.
 - ii. Injection pressure max and averages, annulus pressures, and flow rates are reported on a monthly basis for each well. The Brinkerhoff 3A will be added to this report. This pressure measurement and rate are measured at the wellhead of the injection well with certified and calibrated pressure gauges that are maintained annually. The flowrate will be measured with a 3" Turbine meter model TMO300, which is the same meter we use for all injection wells in Steamboat.

Comment 21: The fracture gradients referenced in the application are for the Tensleep and/or Phosphoria Formations in the Steamboat Butte Field. Please provide any available regional fracture gradients calculated for the Crow Mountain Sandstone Member of the Chugwater Formation. If no fracture gradient data is available, EPA intends to conservatively assign a fracture gradient of 0.5 pounds per square inch per foot (psi/ft) to calculate a temporary Maximum Allowable Surface Injection Pressure (MAIP) until a step-rate test has been run to determine the actual fracture gradient of the injection zone.

Response:

- a. Appendix A contains the post-job frac report for the Brinkerhoff 4 producing well that was completed and Frac'd into the Crow Mountain (Curtis) in 2018. Merit proposes an MAIP using the calculated Frac gradient for the Crow Mountain sand from this offset well with a 10% safety factor. The ISIP for the DFIT during this frac job was measured to be 1580 psi. Using the equation:
- i. $\text{Frac Gradient} = (\text{ISIP} + \text{Hydrostatic pressure}) / \text{Depth(ft)}$
 - b. We calculated the Frac Gradient of the Crow Mountain sand to be .708 psi/ft. Therefore, Merit proposes a Frac Gradient for the MAIP on the Brinkerhoff 3A to be 10% below this, or .564 psi/ft. In the Brinkerhoff 3A this would correlate to an MAIP of 1180 psi.

Plugging and Abandonment:

Comment 22. The Plugging and Abandonment Procedure contained in Exhibit I includes well information for the Tribal C-13. Please provide a corrected procedure and accompanying diagram that includes the following:

- h. Type and number of plugs to be used.



- i. Type and density of fluid that will be left in place in between plugs.
- j. Placement of each plug including the elevation of top and bottom.
- k. Type, grade, and quantity of cement to be used; and
- l. Method of placement of the plugs.
- m. P&A Diagram

Additionally, please be advised that in order to satisfy the requirements of 40 CFR 146.10, the procedure must include provisions for isolating USDWs within any uncemented portions of the five and one-half (5.5) inch production casing. Further, the plugging abandonment procedure should be consistent with EPA Guidance Document #40. This guidance document can be found at <https://www.epa.gov/uic/underground-injection-control-epa-region-8-co-mt-nd-sd-ut-and-wy>.

Response: Updated Brinkerhoff 3A plugging procedure includes all of this information. Appendix B is the updated plugging procedure.

Financial Responsibility:

Comment 23: Please provide two (2) independent, third-party cost estimates based on the revised and corrected P&A procedure requested in comment no. 18 above. If P&A cost estimates are greater than the \$64,000 financial assurance currently held by EPA for the Brinkerhoff 3A well, an increase in the financial assurance will be requested.

Response: Continental does all of Merit's plugging in the Wyoming region. A P&A quote from them is included in Appendix M.

National Historic Preservation Act and Endangered Species Act Considerations:

Comment 24: Please describe whether the proposed conversion will result in any new surface disturbances outside of the existing well pad.

Response: There will be no new surface disturbance associated with this application at the wellsite or for the injection line. Merit will use the existing production flowline and repurpose it to an injection line after a pressure test to 1500 psi. If repairs are necessary at the time of conversion or in the future they will be made on the existing line, ensuring that no new surface disturbances have been made.

Aquifer Exemption Request:

Comment 25: The aquifer exemption (AE) request for the Crow Mountain Member of the Chugwater Formation includes an area of 2,480 acres; however, the Brinkerhoff 3A is the only EOR injection well completed in this zone that is proposed for the Steamboat Butte Field. As a result, approval of an AE would be limited to the AOR extent for the Brinkerhoff 3A well unless a demonstration can be made that the proposed EOR activities will affect a larger area.

Response: Merit intends to pursue further Crow Mountain (Curtis) injection conversions within the Steamboat field in the future to continue the EOR Waterflood.



Comment 26: Please provide well depth and formation of completion for each well in the table of water wells identified in the Wyoming State Engineer's Office database.

Response: Please see the attached Excel file labeled 'Brinkerhoff 3A – 5-mile radius Water wells from Wyoming SEO'. This file contains the requested information. Additionally, Appendix O shows each of these wells on a map.

Comment 27: Please provide the laboratory analytical results for the production water sample collected from the Brinkerhoff 4 well and clarify whether the sample was collected before or after the fracture stimulation described in Section L of the permit application.

Response:

a. The sample taken on the Brinkerhoff 4 dated 2/13/2018 was taken after the hydraulic fracturing treatment. It is therefore considered to not be representative of the natural quality of the water within the Crow Mountain, because the fracturing fluid was fresh. Appendix N contains all of the water quality samples from the Crow Mountain in Steamboat, as well as the data that is publicly available from the USGS website.

i. After taking another Crow Mountain water sample from the Brinkerhoff 4 in April of 2021 and using the USGS database provided by the EPA, Merit now assesses the Crow Mountain natural water quality to be above the 10,000 mg/L threshold. There a total of 9 samples contained within the USGS database that were taken in the Steamboat Butte and Pilot Butte oilfields. The median TDS value is 38,264 mg/L, with the minimum TDS being 10,550 mg/L.

ii. The Water Analysis information from the USGS database, as well as additional samples Merit has for the area including a new sample taken from the Brinkerhoff 4 on 4/14/2021 that has a TDS of 30,074 mg/L. At the time of original application submission, the lab results from this test had not yet been returned.

Comment 28: Please provide an indication of the regional groundwater flow direction in the Crow Mountain Sandstone Member of the Chugwater Formation. If available, this may be interpolated from reservoir pressure data from production wells completed in the formation.



Response: Merit's understanding of the Crow Mountain formation is that it is currently hydraulically isolated within the Steamboat Butte field. There has been a total of 333 MBO and 449 MBO BW produced from 10 wells within this unit over the past 50+ years. The formation has lost all of its initial pressure and is effectively non-productive at this time. If it was connected to a groundwater flow, then the pressure should have recharged over this 50-year period. If the Crow Mountain was connected to an actively recharging aquifer, the cumulative Water to Oil producing ratio would be much higher.

If you have questions, please contact me at (972) 628-1441.

Sincerely,
MERIT ENERGY COMPANY

Michelle Yalung
Regulatory Analyst